

# Openers, discs, shares and shoes Mulch seeding, strip drilling and direct drilling techniques – a technical overview.

Jan Hinrich Löken (state-certified engineer)  
J.Loeken@industriehof.com



**D**ifferentiating between the terms mulch seeding, strip drilling and direct drilling (no-till farming) is not that easy. Where does one finish and the other start? If you ask farmers, you get a wide range of responses. For one farmer, it's still okay to see a thin black strip when direct drilling, whereas for another, it can no longer be called direct drilling, if just a few too many crumbs of earth are moved. It seems there are as many definitions as there are users. Nevertheless, there is strong growth in this segment here in Europe. This is just as true for the manufacturers as it is for the users. Our neighbours across the pond have been relying on these techniques for quite some time, so it's no wonder that many of the ideas and innovations in this space come from the English-speaking world. Precise, economical, cost-effective and resource-saving methods of spreading seed and fertiliser are increasingly becoming a central theme in modern farming, also in view of water and environmental protection, and the slump in grain prices. It remains to be seen how the industry will develop over the coming years. At some point, the discussion around a total ban on herbicides could at the very least make pure direct drilling, where no soil is moved at all, a little more difficult. This, in turn, could potentially give rise to new product niches, for example to cater to new flaming techniques or other non-chemical processes for controlling weeds. This article, however, is not about specific manufacturers of direct drilling or mulch seeding equipment. Instead, our aim is to shed light on some of the tools that are available, both for seedbed preparation and for directly sowing seed alongside fertiliser, and to provide some recommendations in terms of their areas of application. The technical capabilities of the various machines vary considerably. Firstly, this has to do with where the machines come from and how they have been adapted to specific soil conditions, and secondly, it has to do with what other machinery is used in that region. A machine that is destined for sale in North America, for example, has different working widths and different pull power requirements compared to a machine that is sold in Southern Europe. Nevertheless, many of the techniques are similar and the equipment versions are wide-ranging.

## 1. Seedbed preparation

Many of the manufacturers supply machines that can accomplish both seedbed preparation and sowing in one pass by mounting various additional tools. Aside from pure direct drilling which gets by without any cultivation whatsoever, there is essentially always a need for a certain amount of direct cultivation before sowing. With the strip-till method, only a thin strip is cultivated to successfully sow the seed. With mulch seeding on the other hand, the entire field is cultivated at a shallow depth. Various pieces of equipment are available for this, and in some cases, they can be used in combination.

### 1.1 The CrossBoard

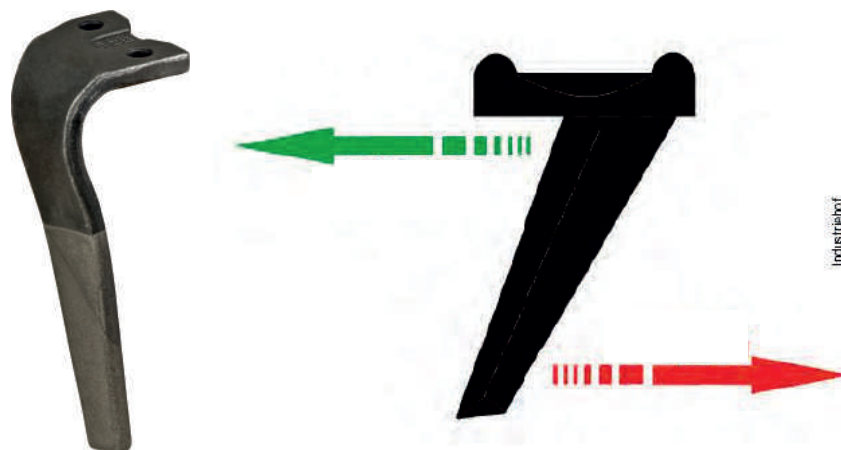
A CrossBoard is often used in the first instance to level out the soil and to distribute straw residues and catch crops. To do this, brake tines and wearing plates are arranged in a line at the front of the machine. Both the brake tines and the wearing plates are available in various formats and strengths. A CrossBoard does not create a seedbed in the true sense of the word. The primary goal of this process is to prevent any machine blockages due to a build-up of residues ahead of the seed units or preceding cultivation tools. CrossBoards are often automatically adjustable, so that they can easily respond to any changes on the field.



Brake tine with wearing part

### 1.2 The Power Harrow

A power harrow, also known as a rotary cultivator, is used to break down the soil to a finer structure (crumbs) and, if necessary, to chop up harvest residues. After cultivating or ploughing without a furrow press, for example, it creates a level seedbed with a fine tilth. Depending on the model, the tines you use can be installed either trailing or on grip. Depending on what you want to achieve, it can make sense to readjust the tines each time you change fields. For this reason, many of the manufacturers already provide a quick-change system for the tines. Certain manufacturers have different machines that look the same from the outside, yet the components they use are geared to the horsepower of the tractor. This can often include different tines that are installed, which sometimes have the same geometry but are not always suitable for installing in all models.



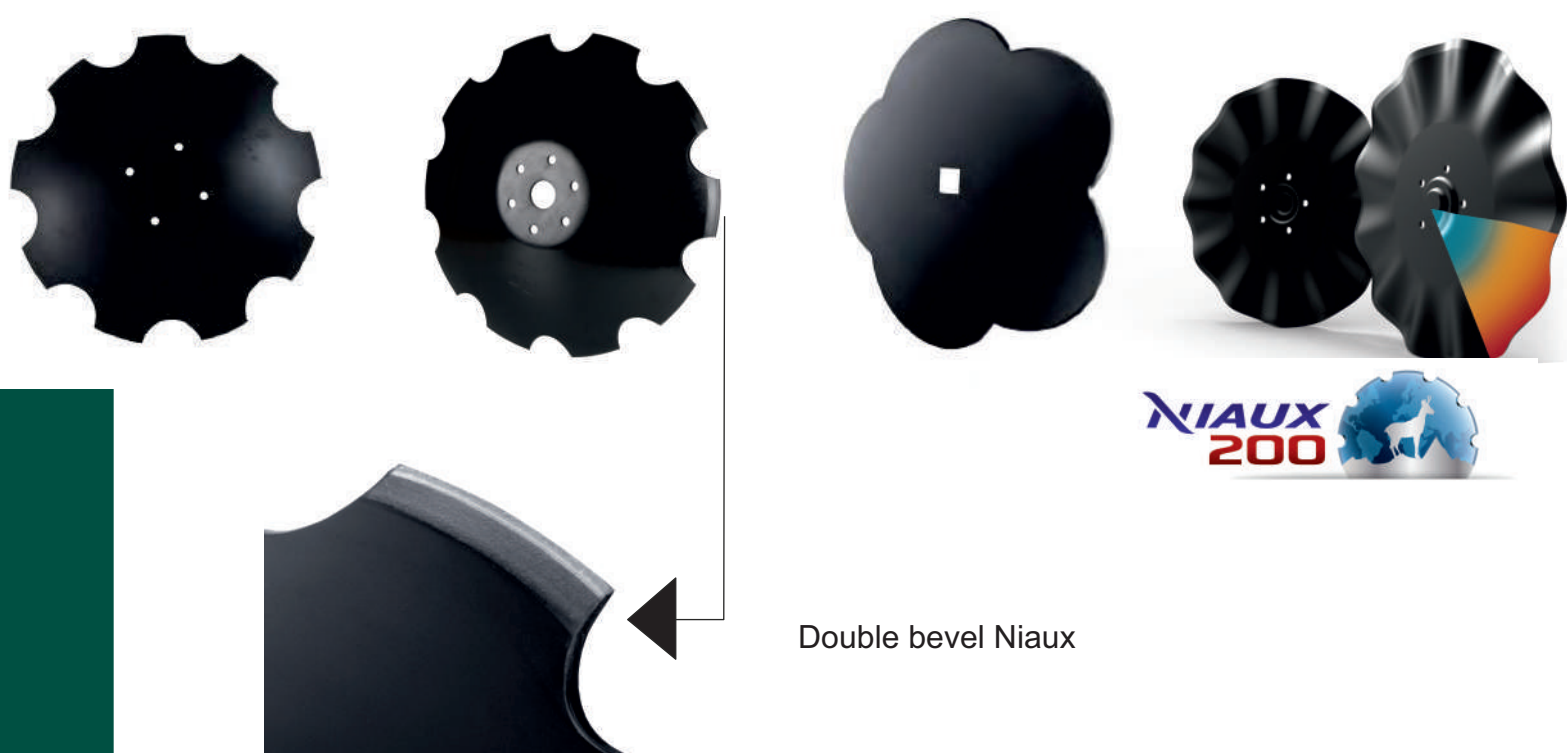
Rotary harrow tines/Grip and trailing diagram



Tines for power harrows with a so-called DURAFACE coating continue to be available in many cases. The coating is made from chrome carbide or tungsten carbide and is applied to the finished tines through a dipping process. Its purpose is to reduce wear. The disadvantage is that the cold tines are dipped into a hot molten mass. This leads to distortions in the material along the edge of the coated area. In the worst case, this can cause the tine to break, if it hits a large obstruction, such as a stone, for example. For this reason, they are not recommended for use in stony soils. Following the rotors, there is a roller for height control and reconsolidation. With each manufacturer, there are usually several models to choose from depending on your soil conditions and desired hardpan density. Equipped with a three-point linkage towards the rear and in some cases even its own hydraulic system, a power harrow can be used to carry a seed drill in combination. Due to their compact construction, these machines are ideal for mounting on a three-point linkage, even with smaller tractors.

### 1.3 Concave discs

Without a doubt, the tools most used for seedbed preparation on mulch seeding machines are concave discs. Often arranged back-to-back in two rows, they are used to chop up harvest residues and cover crops, and to mix them into the soil. This method also helps to achieve a good seedbed. However, the resulting soil structure is nowhere near as fine as when working with a power harrow. Depending on the manufacturer, some discs are automatically height-adjustable, which means they can be easily adjusted to suit changing soil conditions. As with a compact disc harrow, the offset arrangement of the discs prevents the machine from becoming warped to one side. Notched discs are the most used because they guarantee light soil penetration, even in difficult conditions. Other shapes are available depending on the manufacturer. Examples of these include “cloverleaf” and “cutting” discs. Occasionally, coulter discs with varying degrees of waviness are also used. These tend to cut more than they mix, but they can still achieve a good result. Ultimately, it's up to you as the user to choose the right disc for your farm based on your own practical experience.



Double bevel Niaux





## 1.4 Harrow tines

Tines are not generally used for seedbed preparation on modern machines, but they are used in a few isolated cases. As with a typical fine cultivator, several rows of harrow tines are used with small duckfoot or narrow shares in this case. This method of seedbed preparation is more suitable if another pass of cultivation has taken place previously, because harvest residues and cover crops can lead to blockages here, too. This is primarily because the harrow tines do not have much clearance. They tend to have a cross section of 32 x 12 mm or 45 x 12 mm and are then normally fitted with duckfoot shares with working widths of 150–200 mm, although reversible narrow shares are occasionally used, as well. On many machines, however, the tines are simply used to loosen up tyre tracks and keep the compression as consistent as possible.



## 2. Sowing

The tools available for spreading seed and fertiliser are seed drill discs, seed shares and combinations of the two. Aside from this, you also have the option to attach seed tubes to your harrow tines or discs in order to sow a catch crop during cultivation.

S tine with narrow share

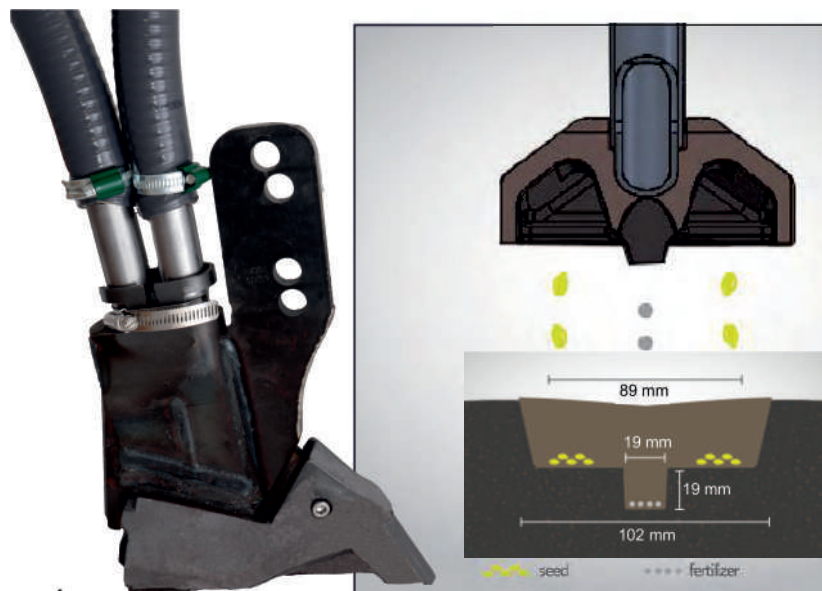
### 2.1 Seed shares

Shares are generally described as openers. In this case, there are some manufacturers that sometimes only offer tools for retrofitting onto existing systems. These are then adapted to the geometry of each machine. Unfortunately, it cannot always be warranted for that the positioning and alignment will ultimately be the same as the original. As such, the mounting and alignment options should be taken into consideration when retrofitting non-native systems, because otherwise it could lead to soil smearing. What's more, using shares for pure direct drilling does not come without its problems. Main and catch crop residues with long fibres can lead to blockages in the machine. Therefore, it makes sense to at least have a cutting disc in front of the share to cut through the plant material and enable the opener to run through the cut. In doing so, the key is to use the highest quality self-sharpening discs, because a blunt blade could press plant residues into the seed furrow. At worst, this can prevent the seed from emerging.

It is also important to regularly monitor the discs and, if necessary, to replace any blunt ones in due time. Some retrofit systems enable you to adjust the shares to different conditions and seed types. For example, fertiliser can be placed at different depths.

This is an important criterion when deciding which system to choose, especially regarding the potential for seed to become contaminated by liquid fertilisers, which can lead to seed burn from some aggressive fertilisers. Even the width of the seed strip is often variable. Additional drills and channels can also be drawn into the soil by special geometric features, in order to better facilitate drainage or root growth.

Bourgault opener/ Seed placement



## 2.2 Seed drill discs

Usually used in tandem and designed to be slightly concave, these discs open a furrow in which seed and fertiliser can be placed. The discs come in different variations. Many have a smooth edge, while others are slightly toothed. Some makes only have one disc to act as a clearer in front of a special seed tube, which usually has a hard metal coating to prevent wear. The tube often serves as a scraper for the discs. When using two discs, the scraper is often guided separately above the seed furrow on the discs. Regardless of the soil conditions on your farm, you should always have a scraper to avoid blockages in the seed unit and consequently any missed spots on the field. Seed drill discs have the major advantage of being able to drill in any soil, because crop residues and catch crops are carved up by the discs. Separating the seed and fertiliser placement is a little more difficult in this case because both are usually placed in one seed furrow. The seed depth is only adjustable overall.



Seed drill disc

Furthermore, the soil on the side walls of the seed furrow can sometimes become compacted when using a double disc share. This in turn can have a negative impact on the crop emergence. If possible, a system with pressure regulation should be used to avoid this. In cases where undersown crops are often sown in parallel, it is advisable to consider installing multiple separate seed units in the machine. This enables one row to be sown with the main crop and the other with the under sown crop, and the segments to be adapted separately to the necessary requirements. An additional advantage here would be two separate seed hoppers. Sometimes, the seed can get mixed up in the hopper due to vibrations in the machine – especially when the under sown crop and main crop seeds are vastly different in size - which can lead to missed spots on the field.

## 2.3 Hybrids

There is a wide range of different equipment on the market for creating a seed furrow. Over the past few years, disc/share hybrids have become ever more popular. They create the ideal double furrow by using a split share with a coulter disc running in between, which enables fertiliser to be placed on one side and seed on the other. This achieves a clean separation between seed and fertiliser. The placement of the seed channels in relation to the cutting depth of the coulter disc also ensures that no organic matter comes into direct contact with the seed.



## 2.4 Seed tubes

Seed tubes, also known as “seed boots”, are intended to be mounted on a typical cultivator. By using a small pneumatic spreader on the cultivator, these enable a catch crop to be sown during cultivation. The tubes are available in various models and widths. Attached either singly or in pairs to the main shaft at the rear of a single duckfoot share (wide or narrow), they enable a catch crop to be sown straight into the mixed soil. The disadvantages of this type of equipment are insufficient reconsolidation of the soil by the cultivator, which is associated with poor crop emergence, imprecise metering by the spreader and crop damage from wild birds, which, because of seed depth being imprecise and some grains remaining on the surface, can be more extensive than if the catch crop had been sown using a seed drill. If the seed blend contains varieties that serve a specific purpose – for example radishes – to loosen up deeper soil layers, sowing should be carried out as precisely as possible so as not to be hindered these effects.



Bourgault seed boot with duckfoot share

Industriehof

## 3. Soil closure

One of the most important aspects of successful, sustainable sowing follows, once the seed and fertiliser have been inserted. Getting the right level of compression in the seed layer is crucial to ensuring an even emergence. This can be achieved by either pressure rollers behind the seed units or a trailed furrow press. The choice of consolidation tool used here can significantly affect the emergence and thus also the yield. In some cases, differences in yield of up to 30% can be detected. But again, this all depends on your farm and its circumstances.

### 3.1 Pressure rollers

Pressure rollers are carried directly behind the seed unit, regardless of whether the machine uses openers or discs. The rollers are used to close and press down the seed furrow. As a rule, the seed unit is also guided by the rollers. In some cases, they are the only reconsolidation tools on the machine. Trailed furrow presses are not available on all machines. In this case, the shape of the rollers and the pressure at which they are set are crucial for the hardpan density and associated crop emergence.



Pressure roller



## 3.2 The furrow press

Some makes have a wide variety of options. In addition to tyre packers, which are almost universally available, equipment versions with U-profile ring, roof ring, ring and spring balance rollers are available as well as fully welded discs. Where technically possible, it can make sense to use a combination of different geometries. This enables the level of soil compression to be varied within the row and in between, which can have a considerable impact on the emergence of weeds between the seed rows, on water uptake and on soil erosion. With under sown crops it can make sense to adapt the soil compression to the crop in the relevant rows.

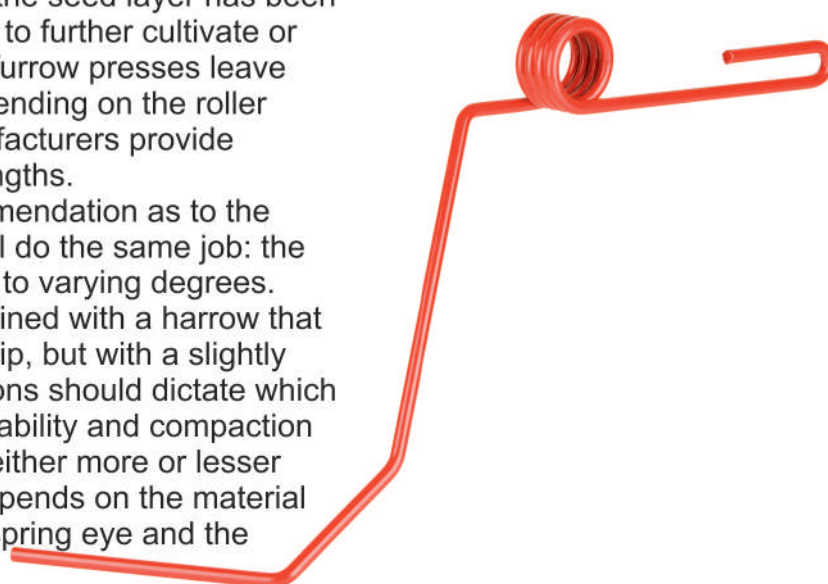
## 3.3 Harrows

Once the seed has been sown and the seed layer has been reconsolidated, you have the option to further cultivate or level the surface of the field. Some furrow presses leave behind furrows of various sizes depending on the roller geometries. To avoid this, the manufacturers provide harrows in various shapes and strengths.

In principle, there is no clear recommendation as to the shape or design. Essentially, they all do the same job: the soil surface is left level and crumbly to varying degrees. However, seed drills are often combined with a harrow that does not touch the ground with the tip, but with a slightly longer area. Your farm's soil conditions should dictate which one to choose. Depending on the stability and compaction of the soil, the harrow should have either more or lesser vertical elasticity. The spring rate depends on the material thickness of the lever length to the spring eye and the number of coils in the spring eye.

On many machines, the harrow fixtures can also be adjusted, allowing different levels of pressure on the harrow itself.

Accord harrow



In conclusion, whether you're mulch seeding, strip drilling or direct drilling, the range of machinery and equipment available should offer something suitable for all conditions. Since there is such a wide range of products available from the relevant manufacturers, you should feel free to ask for advice. And because most machine types can be obtained from one manufacturer, the quality of the advice in terms of their range of applications is very high and often backed up by field tests. Unfortunately, because of the coronavirus pandemic, it is difficult to come across any public events where you could see any number of machines from various manufacturers being demonstrated parallel to one another, providing for a chance to examine the results. This is usually the best opportunity for you to fully comprehend the advantages and disadvantages. If you're not sure, or you're considering building or converting one of your machines so that it is better adapted to your farm's conditions, you can arrange for a demo machine to be brought to your farm. Many of the manufacturers provide this type of service. It can become complicated, however, if you prefer a manufacturer that is not based on the European continent and may not maintain a sales presence here. In this case, your only option is to look for machines that have been purchased nearby. Some manufacturers can provide a list of the reference contacts upon request. In any case, you'll find a wide variety of test reports by both users and manufacturers on the internet.

